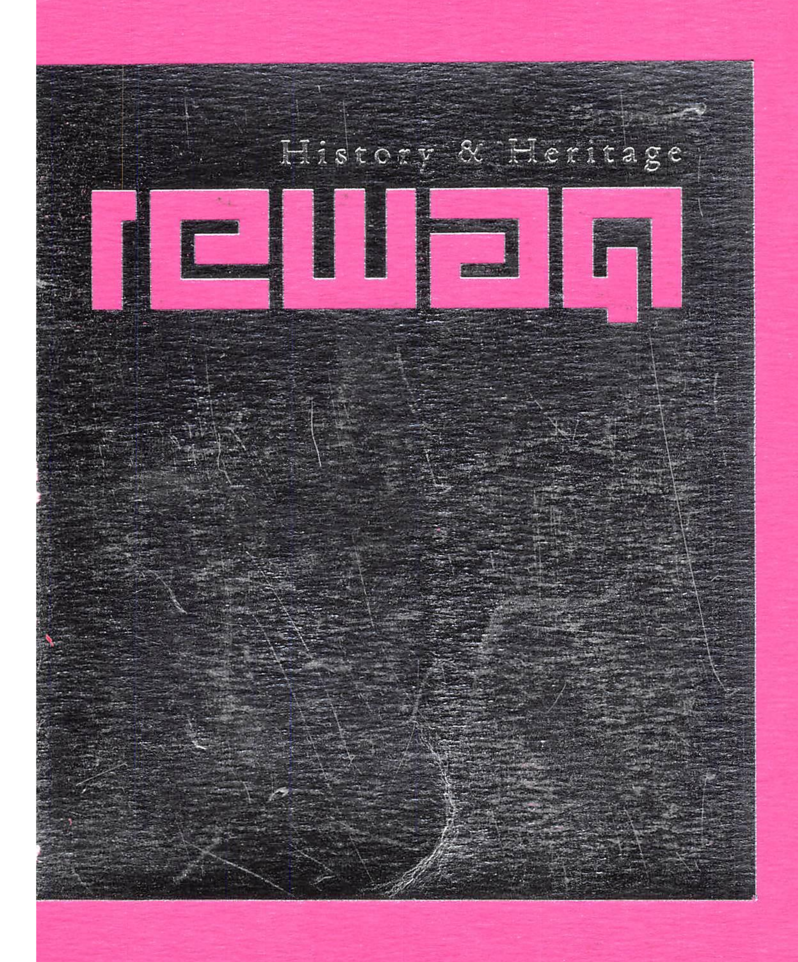
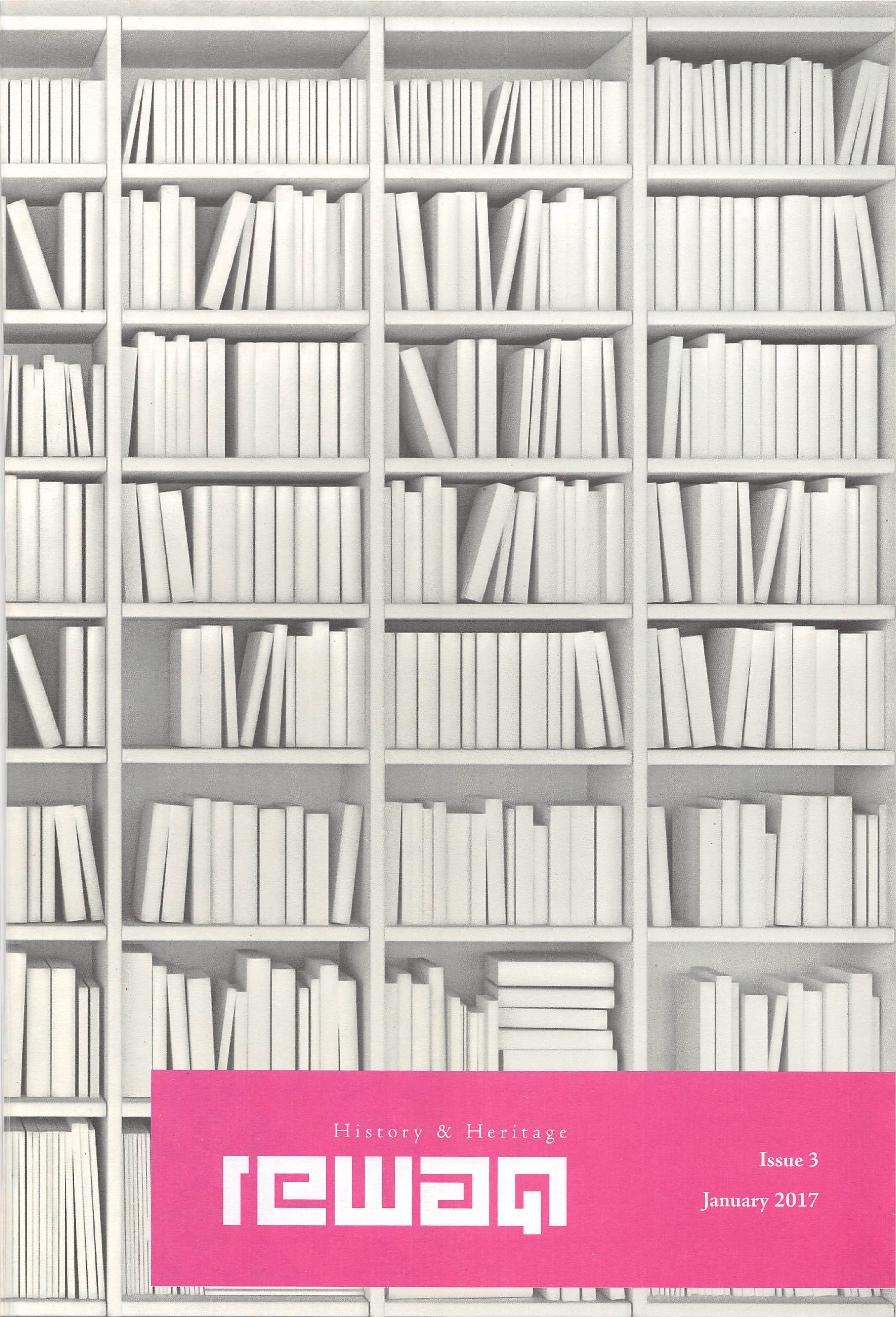


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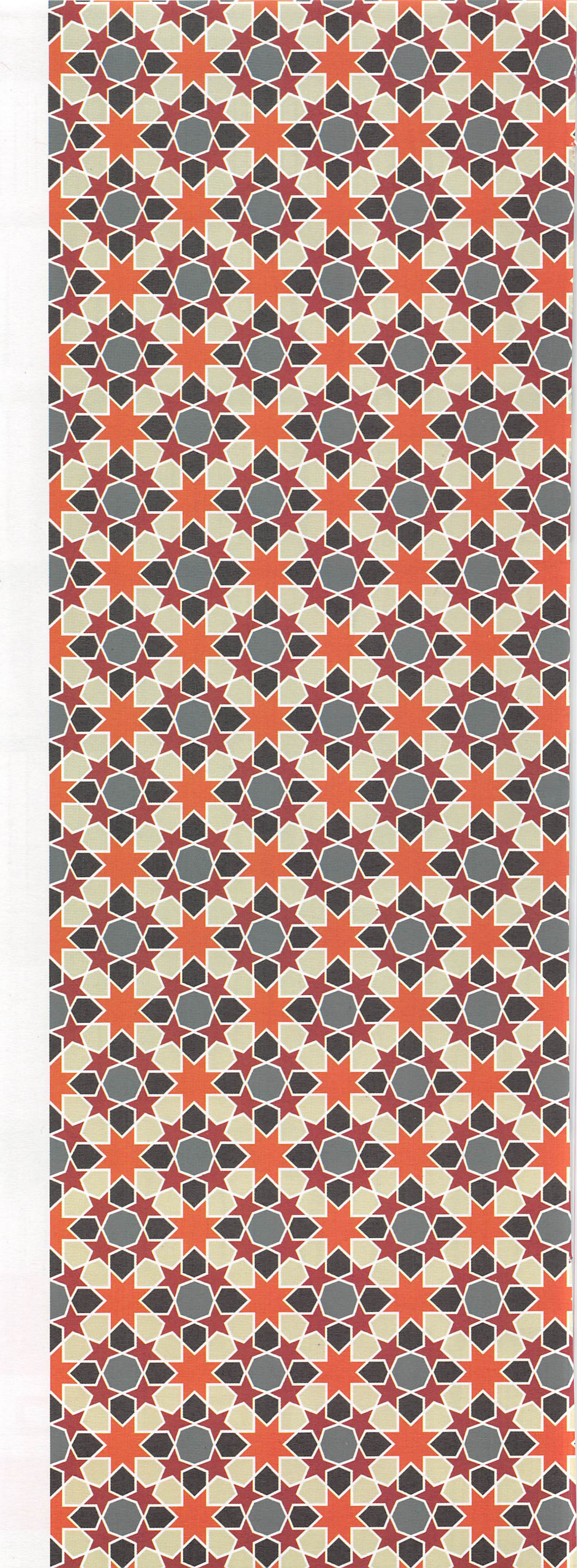

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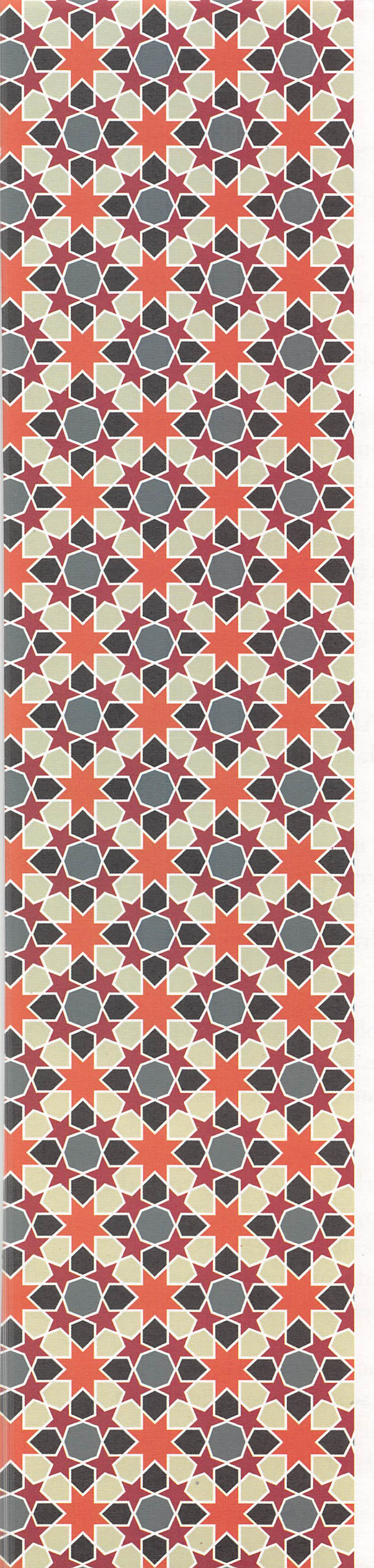
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3- References should be inserted automatically in sequential ordering.

4- Images and illustrations may be inserted provided that they are original, and the author shall obtain their publishing rights.

5- Terminologies of foreign languages should be written in their original language.

6- The material should be written on A4 word document using Arial font, and it shall not exceed thirty pages including images, illustrations and other attachments.

7- Contributions shall be subject to secret refereeing by specialists.

8- The journal shall not give reason why the material was not accepted for publication and is not required to return it.

9- The researcher shall review the material related to his research after preparing it for publication and before sending it to printing press.

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11- The author shall provide a summary that does not exceed fifty words, and he shall also provide an abstract biography and 4x6 cm photo of the author.

12- The author shall receive one free copy of the issue in which his article is published.

INTRODUCTION

The significant thinker Michael Morgan contribute in this issue his English research about Pope Sylvester II, as being the first influential European man strived to communicate the Islamic Arab scientific knowledge to Europe.

Dr. Mubarak Abu Asab contributes an article about weaponry technology at the Saadi age, the dawn of the modern age in Morocco, through the manuscript (el-Izz wa-al-manāfi‘ lil-mujāhidīn fī sabīl Allāh bi-ālāt al-ḥurūb wa-al-madāfi‘).

Dr. Nasir Ibrahim presents a new source of the history of Mamluks in Egypt; that is "Mamluks Messages" (Jawabat al-Mamalik), which reveals the relationship of the French with Mamluks and the society, and which discuss the reality of the Mamluks and the nature of their political and cultural disposition.

Dr. Sahib Nadwi reviews the contributions of the Indian scientists in writing the biographies about the companions and the followers in Arabic and local Indian languages, he reviews also their efforts in propagating Islam and Islamic culture in India.

Dr. Salma Ismail talks about the popular heritage, in all its varieties and types at the theoretical level, for the purpose of using it as a source for studying the Islamic history. At the practical level, she reviews the biography of Ali El Zeibaq as an example that demonstrates the historical connotations drawn from the characters and facts of the biography.

Dr. Mustafa Wajih affirms that most of the popular revolutions in Egypt at the time of the Mamluk Sultans did not occur but for two reasons; religion and food. He reviews the role of the subjects and the most important ways adopted by popular classes during high price levels or food crises.

Finally, Dr. Hassan Khalil deals with the documents of the legacies written in the records of the Arab Kismet Court, which were decided by the judges of the court. Thus he presents an image of how the Sharia judiciary dealt with legacies and inheritances in the Ottoman Egypt, in addition to the rules and procedures used by judges to calculate and divide the inheritance to the beneficiaries.

Hence, these articles reflect the approach of the magazine in preserving the high scientific level, which it looks for to serve the scientific research, especially after it has taken its place on shelves of the libraries of universities, included in the digital databases, and have gained the appreciation of researchers of history and heritage.

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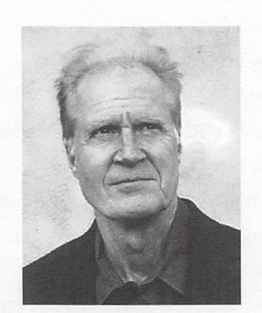
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Sylvester II, the Christian Pope who first brought Arab-Muslim science into Europe

ARABIC ARTICLES



Sylvester II, the Christian Pope who first brought Arab-Muslim science into Europe



Michael Hamilton Morgan

Michael Hamilton Morgan is a former US diplomat and a researcher of Arab and Islamic heritage. He graduated from the University of Virginia. He has been a keynote speaker at the US National Archives and the British Parliament. From 1980-87 he was the Deputy Staff Director of the U.S. Advisory Commission on Public Diplomacy. His book Arabia: In Search of the Golden Ages won the Silver Nautilus Award. Among his other books about the golden age of Arabia, the legacy of Arab and Muslim scientists and popular history, the best known include Lost History and Arab Science: Journey of Innovation.

All images in this article were chosen by the writer

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Often-misunderstood Catholic Pope Sylvester II, a forward-thinking and open- minded intellectual, was the first European in a position of power to begin the importation of Arab Muslim scientific knowledge into medieval Europe.

A thousand years ago, the French region of Auvergne was quite different from the Auvergne of today. Although the underlying structure of the land -- hills leading to mountains, dormant volcanoes, winding rivers, green canyons and fertile valleys -- is the same, the passage of history has removed many of the marks of the past. A thousand years ago, wolves and bears still wandered the dark forests which covered more of the land. Feudal castles and monasteries provided the only refuge from disorder. Many of the humble structures that once dotted this land have been lost to time, while others are reduced to hummocks of earth, or their stones have been looted to build newer structures. The nearly pristine wilderness of 1,000 years ago is now marked by towns and cities, roads and highways, railroad lines and light industry. More than 1 million people inhabit this region, a number that would have seemed impossible a millennia ago. And in a once-pristine landscape where poverty and ignorance were once nearly universal, now the wealth of Western Europe is manifest here, with near-universal literacy, the many protections of the national state, and a population devoted to working hard and enjoying leisure time.

Auvergne and France and Europe 1,000 years were only just emerging from the centuries of economic depression and political disorder triggered by the fall of the Roman Empire in 476 CE. The Roman province of Gaul (France) had never achieved the economic development of Roman Italy, and once it fell back into darkness, the fall was a hard one. Assorted warlords and chieftains struggled to rebuild the order of Rome, without success. It was not until an Arab army out of Islamic Spain had marched to within 100 miles of Paris, complete with cavalry and armor, that the French had pulled off a miraculous and surprise victory over the Arabs in the Battle of Tours in 732. The leader of the victors was Charles Martel, grandfather of Charlemagne, and founder of the Carolingian dynasty of the Holy Roman Empire. In this ironic way, it could be said that the arrival of Arab Islam in France helped spark the recovery of at least some sense of European political unity and order.

But battlefield victory is no guarantee of a prosperous and educated society. And so although France and Europe began to evolve into a more stable and integrated political system as they moved from the Dark Ages into the medieval period, European poverty and ignorance continued for centuries more.

In the France of the late 950s, the only way out of poverty and servitude, aside from being a feudal lord, was the Church. In limited fashion, the Church could provide education, food and shelter to a select number of men and women. If one was smart, industrious, pious and loyal, one might aspire to a life better than what one found at birth, which was one of hard labor, untreated illnesses, hunger, fear and untimely death.

It was in this way that a young boy named Gerbert, of uncommon intelligence yet born into grinding poverty in 945 CE, gradually found his way to the monastery of St. Gerald of Aurillac when he was about 17 years old. And there he became a novice of the Church, particularly distinguishing himself to his elders and tutors by his studious and inquisitive nature, his



The Battle of Tours, Steuben, 1836

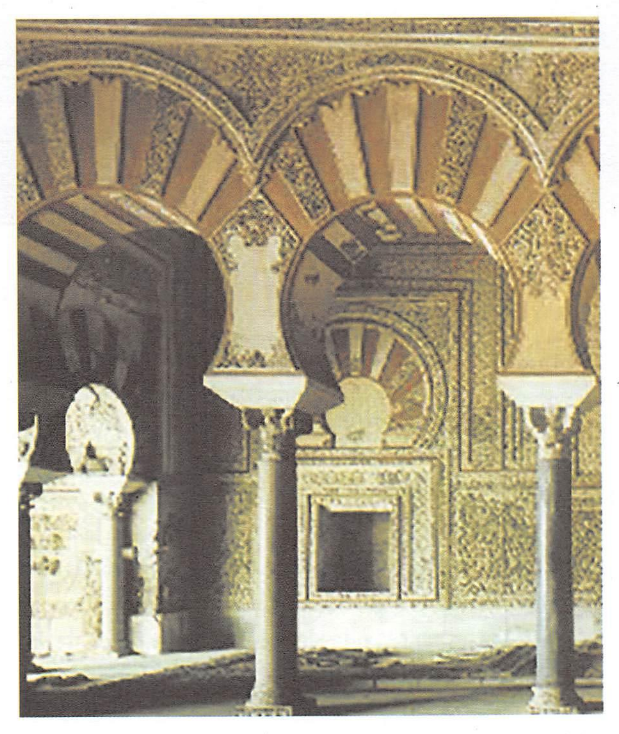
love of manuscripts and knowledge. When he was 21, a noble from Christian Catalan, Count Borrell II of Barcelona, visited the monastery. The French monks convinced Borrell that he should take the boy Gerbert back to Catalan to study science and mathematics. The count agreed, and Gerbert was taken back to the tutelage of Bishop Atto, and access to the much richer monastery of Santa Maria de Ripoll.

It is important to remember the historical context into which Gerbert was born and educated. The "undeveloped" world was Europe; the 'developed' world was represented by the Umayyad Caliphate in Spain, the Fatimids in North Africa, the Abbasids and their successors in Baghdad, the Byzantine Empire and the assorted emirates of North Africa and the Middle East. The Umayyad Caliphate in Cordoba was more than 200 years old when Gerbert moved south, while the Abbasids had ruled in Baghdad for an equal time, and the Fatimid Caliphate in Cairo was also at its peak. The Bayt al Hikmat in Baghdad, the Dar al Hikmat in Cairo and the thinkers of al Andalus in Cordoba had created libraries of knowledge and discovery whose discoveries had circled the Mediterranean, but had not yet penetrated north of the Pyrenees and Alps in any significant way. The great Arab and Persian discoveries were known largely in European fable, too often mischaracterized as magic and sorcery when in fact they were the results of an early version of the empirical scientific method -- the beginnings of modern science testing a hypothesis against experimentation and measurement.

Spain itself, and to a lesser extent Italy and Sicily, were emerging as porous transmission points of Arab discovery and ideas. While the Umayyads controlled the bulk of Spain and Portugal, the Christian kingdoms of Castile and Leon held on in the north, and Barcelona in a state called the Spanish March was also Christian. Over the next 500 years, as Arab power gradually waned in Spain and the Christian kingdoms grew, Spain evolved into a landscape of city-states. Just as the Umayyads had made



The cloister of Gerbert's Monastery de Santa Maria de Ripoll, resembling the Alhambra



Palace in the now-ruined Umayyad royal city of Madinat al Zahra outside Cordoba

multiculturalism a cornerstone of their society populated by Muslims, Jews and Christians, the emerging Spanish city-states also had the same mixed and tolerant character.

This tolerance of culture and religions had also become established in Barcelona, which while ruled by Christians was adjacent to and trading with and battling with the Muslims. And as the various Spanish rulers and warlords did their jobs, they did not have the religious or ideological rigidity that we expect in our world today; it was not unheard of for one Christian leader to make a pact with a Muslim in order to form a common front against another Christian.

It was against this background that Borrell enabled the young Gerbert to study at the lavish Monastery de Santa Maria de Ripoll in Catalan. This center of Christian study, founded in 888, proudly displays the influence of the architectural style of the Umayyads which came to be known as Romanesque, which more accurately should be called Islamo-Romanesque, reflecting the arches, styles and courtyards of the Umayyad Mosque in Cordoba and the royal Alhambra compound in Granada.

It was into this richer and more diverse institution that Gerbert eagerly fell. The humble library at the monastery in Aurillac had contained only 400 manuscripts. The library at Santa Maria was larger, with manuscripts in tongues like Arabic that Gerbert could not yet fathom.

According to scholars, Santa Maria de Ripoll was the intellectual center of Cataluna, a smaller Christian version of the Bayt al Hikmat and other Arab centers of study. The center had been founded by Borcell's ancestor Count Wilfred, the founder of Cataluna. The center of its life was the vast multilingual library, holding many records of the various cultures that preceded or touched Cataluna in some way. The Visigoths had ruled Spain until the arrival of the Arabs in 711 CE, and the library had samples of Visigothic liturgical texts. Among the Arabic and Mozarab (Arabized Spanish Christian) collection was an Arabic translation of Boethius' Arithmetica. Boethius was a Roman thinker and educator of noble blood with the misfortune to have been born just three years after the Ostrogoths overthrew the last Roman Emperor Romulus Augustus and placed themselves on the Roman throne. Boethius did manage to become a consul during the Ostrogothic time, as did two of his sons, but eventually he was falsely accused of treason and put to



The Umayyad court in Cordoba

death. Boethius was one of the critical links to Greco-Roman knowledge that the Arabs later translated. In the same way, a small army of monks at Santa Maria was engaged in this kind of re-translation, bringing Greco-Roman and Arab ideas back into Latin. This feverish intellectual rediscovery excited Gerbert and exposed him to new and rediscovered ideas.

During this period in Cataluna, Gerbert was taken to meet Pope John XIII as well as Holy Roman Emperor Otto I. Both reportedly took note of Gerbert's advanced scientific and mathematical knowledge. Otto eventually made Gerbert the tutor to his son and heir Otto II, and the Ottonians would become political allies and sponsors of the rising Gerbert.

The bishop of the region was Atto, and Gerbert studied under Atto. In 967, Count Borrell realized that the Umayyad emirate in Cordoba, led by the powerful Emir al Hakim II, was within reach of a decisive military victory over Borrell and the Catalans. Rather than suffer major defeat, Borrell decided to journey to Cordoba to propose a truce to the Emir. Gerbert would have given anything to be part of the Count's delegation, but instead Bishop Atto was chosen to travel with the Count.

Apparently Atto, like other first-time European visitors to Cordoba and al Andalus, was dumbstruck at what he found. On an economic, educational and technical level, Cordoba was probably 500 years ahead of cities to the north of the Pyrenees. Cordoba and neighboring Sevilla were the most advanced cities in Europe.

The Spanish Umayyads had brought their style and sophistication born in the wealth of early Islamic Damascus and Syria to this new state at the other end of the Mediterranean.

Though southern Spain had been visited by all the great Mediterranean cultures including Phoenicians, Jews, Greeks, Romans and Visigoths, it did not reach its pinnacle of development until the arrival of the Umayyad heir Abdul Rahman I in 756, fleeing the victorious Abbasids in Syria and Iraq.

When Borrell and Atto arrived in Cordoba for their meeting with al Hakim II, the city was in its full glory.

The multicultural and multi-religious nature of al Andalus was something that Atto had never experienced so directly.

While Islam was the royal faith and was dominant in the culture. Christians and Jews were numerous. At the time of Borrell's visit, Christians were probably a majority of Andalusians, while Jews had a privileged position in court as advisers. One Sephardic Jewish Andalusian, banker Hasdai ibn Shaprut, would one day rise to become grand vizier the Umayyad rulers.

What Borrell and Atto found was an Arabized yet diverse culture where Christian priests and Jewish rabbis had been schooled in much the same way as the scholars in the Muslim madrasas, everyone speaking Arabic and dressing in Arabic style, and understanding the same scientific and mathematical concepts that to Atto were still only mysteries and magic.

What Atto absorbed was an intensified version of what he had already known in relatively open Barcelona -- a culture of intellectual curiosity and the wealth to support it -- so different from the constricted and impoverished Europe to the north.

Al Hakim II received Borrell with honors, which impressed the Catalan leader. But what especially impressed Atto was that al Hakim and his court seemed more interested in science and ideas than in weapons and battle. For Atto, the concept of a ruling class that was more devoted to culture and ideas was astonishing, when European leaders still built their reputations and their status on their abilities to wage and win war, and to rule by physical force rather than force of ideas.

During his visit, Atto undoubtedly walked the streets of Cordoba treasuring every moment he was there. He was told that the court library in Cordoba may have held as many as 400,000 volumes ... a number he could not fathom. He was told the library had manuscripts from Persia and India, from China and Africa, from Baghdad and Constantinople.

When Atto returned to Barcelona, he and Gerbert spent many months discussing the phenomenal discoveries of the Arabs, and poring over the Arabic mathematical and scientific texts that were being translated into Latin at Ripoll.

The story might have ended there, with Gerbert become an ever more educated monk, writing his own treatises based on Arab discoveries that might or might not have made their way out into the wider world. But Gerbert had a higher objective. Though Gerbert never stopped his process of intellectual discovery, for the rest of his life he also immersed himself in the politics of the Holy Roman Empire and the Church. Not only was he a frequent visitor with the several popes who held shaky control over the often tumultuous church, but he became quite close to the Ottonian Holy Roman Emperors, Otto I, his son Otto II and grandson Otto III. He served as private tutor to Otto II and III, even as they later helped him rise through the church and political hierarchy. These friendships and associations gave him key appointments like becoming the Abbott of the monastery at Bobbio and later the Archbishop of Ravenna in 998. Gerbert realized and accepted that his own career, and the stability of the church, were deeply entwined with the Ottonian emperors.

As evidence of his political involvement, a number of Gerbert's letters survive, including some of those he wrote to Ottonian Empress Adelaide of Burgundy, who was wife of Emperor Otto I and mother of Otto II. In this letter that follows, Archbishop Gerbert cautiously agrees to excommunicate someone who has offended Adelaide and her family. (In the Catholic tradition, excommunication happens when a member of the faith is prevented by Church officials from receiving the sacrament of Holy Communion, the sacrament based on the "Last Supper" with Jesus and his 12 disciples on the night before he was arrested and crucified by the Romans.)

A letter from Gerbert of Aurillac, archbishop of Reims (995) to Holy Roman Empress Adelaide of Burgundy

I was so affected by grief over the almost unbelievable and very criminal report, that I nearly lost the light of my eyes for weeping, but what you order, that I come to you and give you consolation, would be a good thing but it is impossible. For my days have passed, o sweet and glorious lady, and old age threatens me with the last day. Pleurisy invades my sides, my ears ring, my eyes water, my whole body is pricked by continuous stings. All this year saw me lying in bed from pain and now, barely rising again, recurring pains throw me down every other day. If some rest is given me from pains, I will not be able to forget your beneficence.
Notwthstanding, what the Nicaean synod defined about communion to persons deprived of it seems sufficient, that those who are expelled not be received by others, yet, we will comply with your order in this business with whatever is honorable and appropriate. But since the salvation of souls

must be treated with great moderation, and no one should be removed overhastily from the body and blood of the son of God, through which mystery true life is lived and by the just deprivation of which the living dies, we hold it proper that that military man is worthy first of our admonition, in case he comes to his senses and satisfies your reverence. And we have already long since for these and other excesses removed him and certain others from the threshholds of the church after which they will be separated from the body of the Lord and thence from the communion of all the faithful, and by these steps he will be warned about his salvation and the people of God will be less infected by the contagion of one in the necessary shared dwelling of the military for the evil of this time, and he meanwhile will bear his malice, dishonor, and ruin alone. 1



Emperor Constantine I, 272-337 CE

Gerbert's political efforts with the imperial family paid off. By 999, young Emperor Otto III saw to it that Gerbert would become Pope himself, a phenomenal rise for a poor boy born in a destitute and now vanished village in Auvergne, France. Also of note, Gerbert was the first French Pope.

He was also one of the most intellectual and unconventional thinkers ever to hold that position in the Church. He was so far ahead of his time and place that like all innovators, his advanced scientific thinking and burning passion to bring the futuristic discoveries of the Arabs into Europe made him new enemies, and would be a subject of debate for the next 1,000 years.

Gerbert becomes Pope Sylvester II

The custom for Catholic popes is that when they are first appointed, they choose a name from Church history to adopt as their papal name. In full acknowledgement of his relationship with the Holy Roman Emperors, Gerbert chose the name Sylvester II, in honor of Pope Sylvester I, who aside from being the Pope from 314-335 CE was also advisor and tutor to Emperor Constantine. Constantine was also the first Roman emperor to personally adopt Christianity and to declare that the Roman Empire would officially tolerate Christianity after persecuting it for centuries.

The intellectual leadership of Pope Sylvester II

Although the new pope was immersed in assorted theological questions and religious reforms of the day, Sylvester II is best remembered today for his earth-shaking modernization of European scientific and mathematical thinking. Yet what for him and Europe were astonishing new ways of understanding the world, were simply the long-established practices of the Arab and other Muslim intellectuals in the great cities stretching from Spain across North Africa to Sicily, the Levant, Egypt, Iraq, Persia, Central Asia and beyond.

To fully appreciate the intellectual contributions of Sylvester, it is important to understand the intellectual landscape of Western Europe in the year 1000. It was very different from that of the culture of Islam in the Middle East, North Africa, India and Central Asia. To put it simply, Western Christianity and Europe had taken an anti-intellectual path, when compared to the Arab Muslim world or to Byzantium. Western Christian anti-intellectualism can be explained in part by the trauma of the fall of Rome and the economic depression that followed. It was further expressed in the fatalistic view of life on earth that had developed in Western Christianity. While Eastern Rome based in Constantinople still had the wealth and resources to maintain an intellectual class and time for invention and study, the West no longer had any of that. Instead, the Christian view of "life as suffering" emerged, and it dominated the West until the late medieval period and the Renaissance beginning in the 1400s CE.

Stagnant and poor European economies, lack of major cities or any universities, public ignorance and illiteracy, the feudal system and other factors had induced a belief in "passive suffering". Many people were taught and believed that suffering in earthly life would lead to a better condition after death, in Heaven. Misfortunes such as famine and plague were often perceived as judgements of God, like the Old Testament suffering brought upon Egypt in the time of Moses.

All this was compounded by the Church's deliberate suppression and destruction of its Greco-Roman intellectual roots. The Church suppressed knowledge of all the great Greek thinkers like Aristotle and Plato because they represented "pagan" non-Christian thinking. Even as Caliph al Mamun and his scholars in Baghdad were studying the Greeks, Christian Europe was suppressing their ideas.

As a free and independent thinker within the Western Church, Sylvester represented an entirely different and sometimes shocking view. It could be argued that he was more "Muslim" in his love of knowledge and learning than many Christians. He was more comfortable with the progressive and futuristic thinking of the caliphs of Baghdad, Cairo and Cordoba than he was with his own religious and political heritage in Dark Age and medieval Europe.

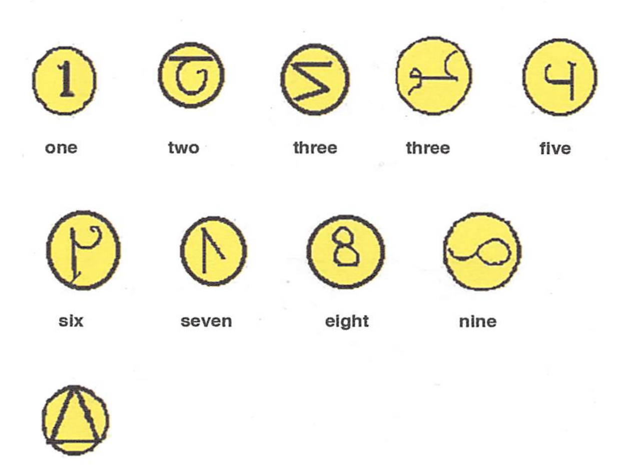
As evidence of that, Sylvester had in his studies at Santa Maria de Ripoll and elsewhere become uniquely adept in several tools that had yet to penetrate into mainstream Europe. These included the Hindu Arabic numerals first brought by the Indian Kanka (or Ganga) to the Bayt al Hikmat of Harun al Rashid in Baghdad in the late 700s, and the astrolabe, a navigational and astronomical device based on positions of the stars and planets, first invented by the Hellenistic Greeks in the epoch of Alexander the Great.

Hundreds of years before Sylvester, the Indians, Arabs and Persians had confronted the issue of how to most clearly and efficiently represent mathematical calculations in writing. The Arabs had initially used verbal representations of problems, or the unwieldy Roman numerals and other Greco-Roman methods. In the early 800s CE, Mohammad al Khwarizmi had discovered in the papers of Kanka a crisp Indian method of representing quantities, based on a decimal system and including the mysterious concept of zero, which didn't exist in Greco-Roman mathematics.

Because of al Khwarizmi, these Indian symbols had become universalized in Islam and would come to be known as the Arabic numerals. The world still uses modified versions of these numerals today, 1000 years after the time of Sylvester. But Sylvester should be credited for their incorporation into Europe, because not only was he one of the first European thinkers to use them, but because as Pope he was in a unique position of power to bring these tools into wider use. His practice of using translations of Arab manuscripts in the late 900s CE stimulated the later surge of Christian and Jewish translations of Arab writings in the 1100s in Spain and Italy.

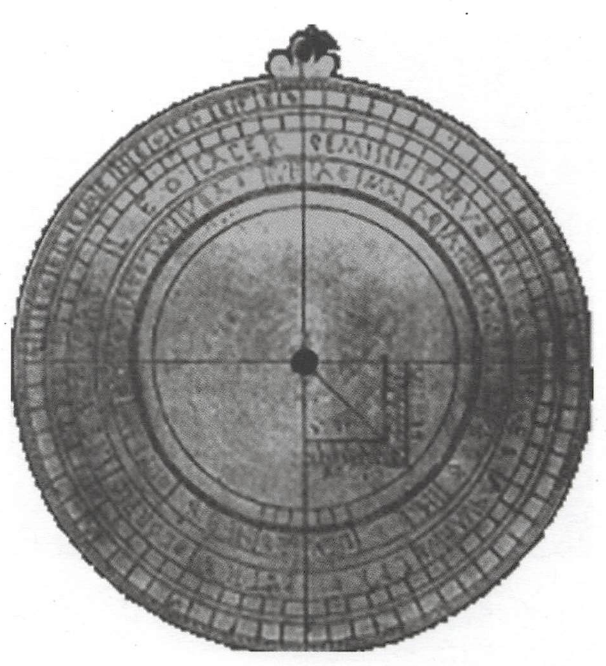
The astrolabe was a navigational and astronomical tool originally developed by the Hellenistic Greeks more than 2,000 years ago, but Muslim thinkers had modified it somewhat to

allow for calculating the qibla (direction of Mecca) and other navigational purposes. Sylvester learned how to use the astrolabe for mathematical purposes such as calculating the altitude of a triangle. Before he was pope, he had become versed in its uses while he was head of the Cathedral School at Rheims, Germany. There he taught his students using the astrolabe, together with another device called the monochord and various spheres to visually explain math. A monochord , also known as sonometer, was an ancient musical and scientific laboratory instrument, originally involving one string/chord. Sylvester was advanced in his belief that mathematics was entwined with music and astronomy – although for early Arab Muslim thinkers like al Kindi and al Khwarizmi, this "unified theory of everything" was also a part of their thinking.



The Hindu-Arabic numerals as adopted and used by Sylvester 2

The astrolabe was explained in several documents of the time, including the Sententiae Astrolabii, translated in the 900s CE from Arabic into Latin by Lupitus of Barcelona. Some believe that paper may have been based on the work of the great al-Khwarizmi. At any rate, scholars have confirmed that there was a copy of it in the library of Santa Maria de Ripoll during the years when Gerbert was studying there.



The astrolabe

Another device that Sylvester used to revolutionize European mathematics was the ancient abacus. This was not an Arab device, but one that probably originated in Mesopotamia 2,000 years before Sylvester and later spread to China, Russia and elsewhere. It was an analog computer that predated the Hindu Arabic numerals and the decimal system. Sylvester reportedly worked with an abacus that had no zero. 12th-century English historian William of Malmesbury says Sylvester may have gotten the idea of the computing device of the abacus from a Spanish Arab.

As Betty Mayfield writes,

> *"Gerbert devised a new kind of abacus which one could use to calculate with the Hindu numerals, a flat board with columns drawn on it, corresponding to ones, tens, hundreds, and so forth. (Some scholars believe he may have been the first person to use the Latin term "abacus".) He had a shield-maker construct small pieces of animal horn with the numerals on them; called apices, the pieces could then be placed on the board to represent numbers. A zero was not necessary; the absence of a marker in the tens' place, for*

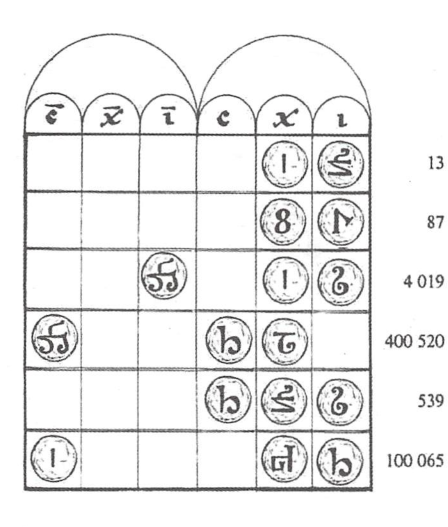
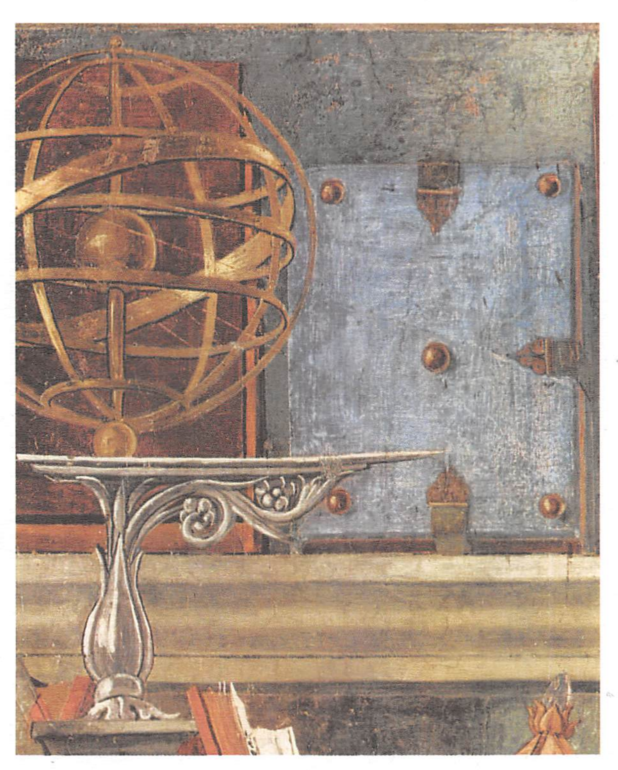


Fig. 241. – Le principe de représentation des nombres entiers au moyen des apices sur l'abaque perfectionné de Gerbert et ses disciples (sur cet abaque, comportant 27 colonnes réunies de trois en trois, les apices prenaient une valeur de position variant selon la colonne où ils étaient disposés ; de plus, l'absence d'unités d'un certain rang y était signifiée en laissant vide la colonne correspondante).

(Apices - Limoges avant 1030)

4



An armillary sphere in a painting by Sandro Botticelli, c. 1480.

instance, meant that there were no tens. An eleventh-century manuscript found in Limoges illustrates the representation of numbers on such an abacus. (Note that the numerals had changed slightly in the next hundred years.)"3

Gerbert catalogued the processes of multiplication, division, addition and subtraction in his manuscript Regula de Abaco Computi One of his students wrote a companion work, Liber Abaci; Fibonacci wrote a book of the same name two centuries later.

Armillary sphere and sighting tube

Sylvester was also struggling with European ignorance about the relative positions and movements of the sun, stars, moon and planets. Ironically, just as Sylvester was bringing earlier Arab-Muslim astronomical knowledge into the West, Arab genius Ibn al Haytham in Cairo was making optical breakthroughs that would later enable the first telescopes and discoveries by Renaissance thinkers Galileo, Leonardo da Vinci and Copernicus. Those discoveries in Cairo would take additional centuries to come north and Sylvester was unaware of them. What Sylvester had to work with were two older tools: the armillary sphere and the sighting tube.

The armillary sphere was simply a mechanical replica of the solar system; before the discoveries of Copernicus, the earth was placed at the center of the device, after Copernicus the sun was at the center

The armillary sphere can be traced to China in the 400s BCE and to Hellenistic Greece several centuries later. Whether the Chinese idea traveled to Greece or the two inventions were coincidental we do not know. What we know of Sylvester's work with those two devices come from his letters to former student Remi, as well as writings of his coworker Constantine and his other student Richer of France. Richer wrote this about Sylvester's technique with the armillary sphere:

"First [Gerbert] demonstrated the form of the world by a plain wooden sphere... thus expressing a very big thing by a little model. Slanting this sphere by its two poles on the horizon, he showed the northern constellations toward the upper pole and the southern toward the lower pole. He kept this position straight using a circle that the Greeks

called horizon, the Latins limitans, because it divides visible stars from those that are not visible. On this horizon line, placed so as to demonstrate practically and plausibly... the rising and setting of the stars, he traced natural outlines to give a greater appearance of reality to the constellations... He divided a sphere in half, letting the tube represent the diameter, the one end representing the north pole, the other the south pole. Then he divided the semicircle from one pole to the other into thirty parts. Six lines drawn from the pole he drew a heavy ring to represent the arctic polar circle. Five divisions below this he placed another line to represent the tropic of Cancer. Four parts lower he drew a line for the equinoctial circle [the equator]. The remaining distance to the south pole is divided by the same dimensions. 5

Historian Oscar G. Darlington asserts that Gerbert's method was accurate in showing the position of the equator, was several degrees off in showing the Arctic and Antarctic Circles and close to accurate showing the Tropic of Cancer.

Richer describes how Gerbert used the sphere to better observe the planets as follows:

"He succeeded equally in showing the paths of the planets when they come near or withdraw from the earth. He fashioned first an armillary sphere. He joined the two circles called by the Greeks coluri and by the Latins incidentes because they fell upon each other, and at their extremities he placed the poles. He drew with great art and accuracy, across the colures, five other circles called parallels, which, from one pole to the other, divided the half of the sphere into thirty parts. He put six of these thirty parts of the half-sphere between the pole and the first circle; five between the first and the second; from the second to the third, four; from the third to the fourth, four again; five from the fourth to the fifth; and from the fifth to the pole, six. On these five circles he placed obliquely the circles that the Greeks call loxos orzoe, the Latins obliques or vitalis (the zodiac) because it contained the figures of the animals ascribed to the planets. On the inside of this oblique circle he figured with an extraordinary art the orbits traversed by the planets, whose paths and heights he demonstrated perfectly to his pupils, as well as their respective distances." 6

According to Richer, Gerbert made clear how sighting tubes could be attached to the armillary sphere to make it correspond to external reality: while a sighting tube was pointed at the north star in the sky, others on the sphere were used to measure the poles, the equator, Arctic circle, and Tropic of Cancer and Capricorn.7

Pope Sylvester II and the Devil in an illustration of c. 1460.

As noted earlier, thinkers and leaders who are ahead of their time usually spawn opposition from those who do not understand the new ideas or are somehow threatened by new ways of seeing the world. This happened with Galileo in Italy vs the Church, Caliph al Mamun in Baghdad in his struggle with ibn Hanbal, Mughal Emperor Akbar the Great, and Omar Khayyam in Persia. Sylvester II was no exception.

Sylvester only served as Pope from 999 to 1003. His patron Otto III died in 1002, and Sylvester was forced to flee a partisan uprising in Rome. Sylvester died in 1003 either of natural causes or in a possible assassination. Once dead, his enemies began to weave various slanders to discredit him.

His enemies were of two camps. The first were the partisan allies of the French Capetian kings who supported rivals of Sylvester for the Archbishopric of Rheims, and who claimed that his papacy was not legitimate because his patrons were the Ottonian emperors. There were other critics of Sylvester who were threatened in some way by his advanced views of science and math. His enemies also included European Islamophobes who insisted that Islam was the implacable enemy of Christianity and Europe, and even worse, that the rival faith was heresy and blasphemy and employed methods of sorcery and black magic.

Some of the worst attacks came from English monk William of Malmesbury in De Rebus Gestis Regum Anglorum and from Cardinal Benon, a Capetian partisan who also argued that local church officials should be appointed by the king and not the Pope. Other critics and slanderers included Michael the Scot and Dominican friar Martin the Pole.

1,000 years later, the attacks seem silly. But for hundreds of



Islamophobic and Christian slanders against Sylvester II

12th century copy of De geometria

years after his death, Sylvester was nearly erased from historical memory except as a strange, illegitimate and demonically-inspired evildoer.

One slander was that while Gerbert was studying in Cordoba and Seville in the Umayyad times, he learned sorcery and that he had stolen a secret book of spells from an Arab philospher. 8

The stories grew over time. He was accused of using his "Muslim sorcery" to build a bronze robotic head that would answer important questions that only Sylvester could ask it.

He was supposed to have made a pact with a female demon named Meridiana, who told him that he would die after traveling to Jerusalem, so he made a point of never going there. Meridiana was supposed to have used her demonic powers to help him win the Papacy, while another story said Sylvester won the Papacy by playing dice with Satan. Late legend came to say that Sylvester died when Satan attacked him while he was preforming Mass in Rome and cut out his eyes in front of the worshippers.

In the ignorance and misinformation of 1,000 years ago, such tales traveled far and wide. It took 600 years before the Church rehabilitated the accused "Muslim Pope".

As Nancy Marie Brown writes,

> *"... in 1602, the papal librarian Cardinal Baronius came across a collection of Pope Sylvester's letters and concluded he "was nothing but a learned man who was ahead of his time. Those who want to efface his name from the catalogue of popes are ignorant fools." 9*

Today, some are rediscovering that Sylvester was an advanced thinker, a bridge between historical Christianity and Islam, and a devotee of scientific research, truth and modernism. While his achievements may seem modest in a world of space travel, digital computing and genetic engineering, it was his early steps that helped start the transformation of Europe and the West from one of the world's most backward regions, to its later role as the home of the Renaissance, Enlightenment, and Industrial and Scientific Revolutions. What is just as important is the rediscovery that despite the efforts of those who still try and drive Christianity and Islam apart, or who focus exclusively on the conflicts between the two cultures, the historical truth is that these two faiths

and cultures have had deep influence on one another for more than 1,000 years, and that this influence has led to many of the advances of the modern world.

Known Scientific and Mathematical Works by Sylvester II/Gerbert of Aurillac

Mathematical writings 10

Libellus de numerorum divisione

De geometria[

Regula de abaco computi[

Liber abaci

Libellus de rationali et ratione uti[

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EUROPÆ PARS
MARE MAGIORE ol. PONTVS
BVLGARIA
MOLDAVIA
ROMANIA
NATOLIA
ASIA
CARAMANIA
MARE MEDITERRANEUM
CANDIA CRETA
LYCIUM MARE.
PAMPHYLIUM MARE
CYPRUS
MARE SYRIACUM
LYBICVM MARE.
BARCHA
MARE ÆGYPTICUM.
ÆGYPTUS
SAHID
Tropicus Caneri
AFRICÆ
NVBIÆ
BELLO
REGNI
PA R
PARS
TVRCICVM IMPERIVM



TARTARIÆ PARS
ASTRACAN NOVA
MARE DE BACHU al. CASPIUM MARE ET HYRCANUM
MENGRELIA
GIORGIA
TURCOMANIA
ARMENIA
CURDI
MEDIA
GILAN
SERVAN
BINGIUL
ASYRIA
MESOPOTAMIA
ALIDULI
DIARBECH
CUSISTAN
PERSIÆ PARS
FARCI
ARDEN
CALDEA
ARABIA DESERTA
MARE ELCATIF al. SIN. PERSICUS
ORMUS
AYAMAN
ELCATIF
ARABIA olim
MASCALAT
FELIX
AMANSIRIEDIN
ALIBINALI
THEAMA
GUBELAMAN
IRMIN
HERIT
ZIBIT
ADEN
MARE DE MECCA
RUBRUM SINUS ARABICUS
MARE ARABICUM ET INDICUM